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Competition in a Pure World of Internet Telephony*

Abstract

From the angle of competition policy, Voice over IP looks like a panacea. It not only brings better service, but it also increases competitive pressure on former telecommunications monopolists. This paper points to the largely overlooked downside. In a pure world of Internet telephony, there would be no charge for individual calls, nor for telephony, as distinct from other services running over the uniform network. Specifically, establishing property rights for either of these would be costly, whereas these property rights were automatic and free of charge in switched telephony. Giving voice over IP providers classic telephone numbers would enhance systems competition with switched telephony. But this would make it more difficult for clients to swap providers. The anti-competitive caller pays principle would extend to IP telephony.

JEL: D 23, D43, H41, K21, K23, L13, L15, L43, L86

Keywords: property right, non-linear pricing, pure bundling, club good, cross-subsidisation packet switched telephony

1. The Issue

Nothing is as uncertain as the future. Many analysts see this as the message we should take home from the dispute over how to regulate voice-over IP (Lewin & Williamson, 2005). Packet-switched telephony epitomises an emerging market. While the market is visibly growing rapidly, the course this development will take is largely unclear. Will it be confined to a process innovation for voice communication — providing the same service as before, but at a lower price (Davies, Hardt, & Kelly, 2004)? Or will there be substantial product innovation, revolutionising the quality of voice communication, and how it is combined with other forms of interaction?[1] Will voice-over IP become the killer application for next-generation networks, so that all communication moves to just one network, and the market power of incumbents in these former markets erodes (Dame, Guettler, Leeson, Schultz, & Jensen, 2003)? Will the nomadic use of voice-over IP bring the cell phone industry under competitive pressure?

* I am grateful for comments by Martin Hellwig, Stefan Bechtold and Felix Höffler on an earlier version, and for the linguistic trimming of the paper by Darrell Arnold.

1 Some of the potential effects are listed in the FCC Notice of Proposed Rulemaking in the Matter of IP-Enabled Services, FCC Doc. 04-28 (Feb 12, 2004) # 12-22, http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-04-28A1.pdf.

These are questions for oracles and gurus, not for scientists. Scientists are better at constructing counterfactuals. What would the world look like if, indeed, the classic switched telephony had died out and all traffic were now packet switched? More sharply even: What if all voice communication became but one service, using an all-purpose packet switched network? More precisely even: What if this network were the public Internet? There might be effects in many areas , e.g., spam voice communication, difficulties in locating emergency calls, or encryption to moot governmental wiretapping. All of these possibilities are discussed intensely.[2] The effects on competition are no less politically relevant, but they have been largely overlooked thus far. They are the topic of this paper.

The main argument runs as follows: In the world of classic telephony, providers had two property rights. They could exclude customers from connection to their network. And they could exclude them from placing individual calls. In pure Internet telephony, neither property right exists. This is obvious for individual calls. But it also holds for telephony as such. Nobody with access to the Internet can be excluded from using her connection for voice communication. The only property right is to access to the Internet, for whatever purpose it is used. Property rights thus are flattened out. Providers have less degrees of freedom in their access and pricing policies.

Actually, the difference is not one of technical impossibility. However in switched telephony, both property rights naturally follow from the architecture of the network. In order to be accessible via classic telephony, a household or firm must be connected to the network. And in order to place a call, the provider must establish the connection on the spot. To create a similar situation in Internet telephony, providers would have to invest in technology that artificially creates boundaries. Exclusion comes at a positive cost. This cost is not only pecuniary. Some exclusion technologies presuppose a different network architecture. Others are likely to meet with fierce public resistance, which policy-makers may find hard to overcome. The debate over Narus technology[3] illustrates the point. It empowers access providers to block voice-over IP. Finally, as long as the public Internet persists, users stand a chance to bypass such restrictions by switching to another Internet access provider.

In the switched network, technology is the source of yet another property right. In this network, telephone numbers have technical significance. They allow the switches to temporarily establish the point-to-point connection. Technically, if a user intends to make a contract with another telephone company, she needs another telephone number. Changing one's telephone number is a costly affair. Regulators have stepped in and given users the right to “port” their previous telephone number to the new provider. Different countries have found different solutions for converting the old telephone number into the number technically necessary for establishing the con-

2 These and many other effects are investigated in European Union Commission Staff Working Document on The Treatment of Voice over Internet Protocol under the EU Regulatory Framework (June 14, 2004) http://europa.eu.int/information_society/policy/ecomm/doc/info_centre/commiss_serv_doc/406_14_voip_consult_paper_v2_1.pdf.

3 http://www.narus.com/

nection.[4] This has made it easier to swap providers. But moving from one provider to another still requires some effort. In switched telephony the underlying technology thus gives providers what one may call a property right in the customer relationship, although porting has weakened this.

In packet switched telephony, there is no longer a need for this property right. In general, it suffices for the sender and receiver to use their IP addresses. An additional address is needed if the client is interested in nomadic use. But even then this address need not be managed by the provider of voice-over IP. Any intermediary can handle it. Consequently, in packet switched telephony the link between the institution governing the number space and the provider of voice communication services is severed. Providers thus have much less control of their customer base.

The paper takes up these changes in turn. Section 2 looks at the lost property right in individual calls and in telephony, as distinct from other communication services. Section 3 looks at the lost property right in the customer relationship. Section 4 concludes by sketching out implications for the, presumably extended, transition phase from switched telephony to Internet telephony, and hence for current policy-making.

2. The Lost Property Right in Individual Calls and in Telephony, as a Separate Communications Service

Property rights theory (classic Eggertsson, 1990) is a powerful tool for analysing the opportunity structure. If a rental agreement gives me the right to play the piano, my neighbour must offer me something in return if she wants me to buy an electronic piano and to use headphones. Our game looks fundamentally different if the rental agreement makes my right conditional upon the neighbours' agreement (Coase, 1960). The structure of the game and the payoffs are influenced by the definition of property rights. In order to understand the effects of shifting voice communication to the Internet, one must first analyse property rights in switched telephony (dealt with in Subsection a below). If telecommunications companies and Internet service providers are willing to exert extra effort, they can restore relatively close functional substitutes for the property rights characteristic of switched telephony. In a first step, this possibility is assumed away (Subsection b). Subsequently, the assumption is dropped (Subsection c).

a) Property Rights in Switched Telephony

In classic telephony, the providers' two separate property rights made for a characteristic opportunity structure. Providers were able to charge a split price. They charged a flat price in exchange for granting access to their network. This allowed them to exploit their customers' willingness to

4 The most primitive solution is to forward individual calls. This seems to be the predominant solution in Germany. The French solution is more sophisticated. There is a national database of numbers. It translates them into the information necessary for establishing the connection (Analysys, 2004:26).

pay for two option goods. Over the public switched telephony network, customers were able to call anybody in the world. Likewise they themselves could be reached by everybody else connected to such a network. On top of this, providers charged a second price for individual calls. They received this payment in exchange for a standard private good. In classic telephony, establishing a connection is a service provided ad hoc. Telephone companies must expend effort on both sides to temporarily make a line available.[5] If establishing some connections is more expensive than establishing others, the charges can mirror the cost differential. Traditionally, cost increased with the distance of the connection. This was reflected in prices for calls. Alternatively, providers could choose prices for individual calls so that they reflected different elasticities. Prices were lowest for those types of calls that reacted most sensitively to price increases. Arguably this was true for local calls.

While this way of exploiting the opportunity structure is natural, it is not the only business model. Telephone companies are free to use some of the revenue from granting access in order to finance the effort necessary for handling individual calls. Conversely, they may price (some) calls above their long-run incremental cost. Traditionally, telecommunications companies have adopted this strategy for international calls. Based on this, they have engaged in (third-degree) price discrimination (Pigou, 1932). They have used the additional revenue to finance the infrastructure. Now there is so much competition that telephone companies can no longer exploit this opportunity.

Finally, telephone companies may find it profitable to use pricing schemes that do not exploit the full potential of the existing property rights. Actually, in response to the increasing demand for flat rates, more and more telephone companies are doing this. Since they hold a property right for individual calls, they are also free to charge non-linear tariffs. In the simple-most case, there is one tariff for all customers. Everybody gets a certain number of calls for free, once she has paid a lump sum. Additional calls are priced individually. For a monopoly provider, such a tariff is a tool for discriminating among customers according to their willingness to pay. The provider sets the lump sum such that customers with a low willingness to pay do not buy extra calls. This makes it impossible for customers with a high willingness to pay to mimic those with a low willingness to pay. The two-part tariff thus is a mechanism. It helps the monopoly provider to mitigate the problem of adverse selection resulting from the customers' private information about their individual willingness to pay. An even more sophisticated tariff offers several packages of flat and variable prices (for details see Bolton & Dewatripont, 2005:47-56). If there is competition, such mechanisms work as long as no competitor targets customers with a low willingness to pay. Note that two-part tariffs only use one of the two property rights, the one for individual calls. They should therefore not be mixed up with a separate price solely for the option good.

5 If the caller-pays principle is applied, there is no separate fee collected from the recipient. The recipient's telephone company is remunerated by the caller's telephone company. More below in Section 3.

b) Property Rights in a Pure World of Internet Telephony

In a pure world of Internet telephony, providers face a very different opportunity structure. Naturally, there is only one property right. Network providers may prevent access from those who have not paid for their services. Note two differences from the current situation in the switched network. Not only is there no charge for individual calls. There is not even a separate charge for using the network for the purposes of voice communication. Voice is just one service running over a uniform network.

If they invest in additional technology, providers may artificially create barriers. Then they may re-establish both property rights known from switched telephony. They may also impose different access charges on different user groups. This allows them to set up functional substitutes for the property rights existing in the switched network. Both reactions will be studied in the next section. At this point, they are assumed away in order to more clearly highlight the implications of the new technology.

Under these assumptions telecommunications companies, Internet service providers, and the providers of the specific services necessary to telephone over the Internet[6] offer one and the same package to all their customers. Customers have only one contract. Of necessity, the telecommunications company is their only contracting partner; for this company is the only one possessing the property right. The telecommunications company is faced with a make or buy decision regarding whether to provide either Internet service or services for voice communication in-house. If providers of the different elements are separate firms in the first place, the availability of integrated offers also hinges upon regulation. Those who need a foreign component must have a legal right to it. Once a customer has paid for access to the network, she can use it however she deems fit. Specifically she can telephone as much as she wants with whomever she wants.

There are several ways of describing the incentive effects of the change in the opportunity structure. A first interpretation points to the fact that telecommunications providers loose two degrees of freedom, which they can no longer exploit to charge higher prices to customers with a higher willingness to pay or, equivalently, with a lower elasticity of demand. Providers cannot capitalise on the fact that some users have a high willingness to pay for voice communication and a low willingness to pay for data communication, and vice versa. Since they do not hold a property right for individual calls, neither can providers rely on two-part tariffs. They therefore lack a technology for singling out users with a particularly high willingness to pay for any given content.

A second interpretation only holds for the relationship between voice and data communication. If providers cannot discriminate between these, the effect is the same as if customers had the unlimited right to resell capacity they had bought for one type of communication to users who intend to use it for the other.

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6 These are mainly three services: providing users with specific addresses for voice communication; managing simultaneous interaction; coding and decoding voice signals, for details see (Engel, 2006:89-112).

A third interpretation reads the effect of the property rights structure as an instance of pure bundling. In the traditional technological environment, voice and data communication were separate products. Now both types of content are transmitted over one and the same network, and the provider stands no chance to discriminate between them. Likewise, in classic telephony, it was possible to unbundle the option good and individual calls. If regulators imposed preselection or call-by-call schemes, there were even separate providers for the option good and the private goods. At any rate there were two separate prices for both goods, even if customers bought them from the same provider. In both dimensions, bundling is pure in an environment of pure Internet telephony; for under the assumptions made in this section, there are no stand-alone versions. Note that, unlike in the standard case from the bundling literature, here *un*bundling would be costly.

In general, the antitrust literature is suspicious of bundling.[7] It is regarded as a technology for exploiting a dominant position. There is, however, a counter-argument if the consumption of the good is not rival. As will be shown in greater detail below, this is in principle the case with Internet use. Without bundling, each of the two goods is only open to customers with a willingness to pay at or above the marginal cost for accepting an additional customer. This is inefficient since additional customers could be served at no cost. If two non-rival goods are bundled, the situation improves for those who have a high valuation for only one of the goods. Due to bundling, the provider can charge a uniform price to all customers who have high valuation for at least one of the two goods. Those who value both goods highly receive a rent. The provider is willing to offer the scheme as long as this rent is smaller than the additional revenue from customers with a mixed valuation (Fang & Norman, 2006a;, 2006b; Hellwig, 2004). In this situation, bundling is also efficient.

The argument, however, rests on the assumption that a sufficiently large number of customers hold mixed preferences: While they value one of the two non-rival goods highly, they have little interest in the second. It is not clear to which extent this holds for the Internet. Are there a large number of people who are heavy users of telephony, but who rarely usethe Internet? Or vice versa? A different combination is more likely. It seems that quite a few people want to be connected to the telephone network, but rarely place calls themselves. But is the opposite combination of preferences frequent?

A fourth interpretation relies on a concept that was introduced earlier in this paper when analysing switched telephony. Internet access is treated as a mere option good. Customers pay for the right to use the Internet for whatever purpose. If and how they use it is irrelevant for the price they pay. Consequently, providers have no chance to charge higher prices to customers with an asymmetrically high willingness to pay for any of the specific services. Equivalently, providers cannot discriminate among customers according to the elasticity of their demand for each of these services.

7 See only the DG Competition Discussion Paper on the Application of the Art. 82 of the Treaty to Exclusionary Abuses, Section 8, http://ec.europa.eu/comm/competition/antitrust/others/discpaper2005.pdf.

A fifth way of describing the effects of the altered property rights interprets the Internet as a club good. A club good differs from a public good in that those who do not contribute can be excluded. And it differs from a private good in that consumption is not rival. Specifically, in a club there is no technology to make additional use of the club's resources conditional upon additional contributions to the cost of their provision (Buchanan, 1965). The club management faces a dual problem: Who shall be accepted for membership? At which level shall the good be provided? (Cornes & Sandler, 1996:350). The marginal entrant's willingness to pay (Cornes & Sandler, 1996:379) must therefore be brought in line with the marginal cost of further extending the club, be that in terms of quantity or quality. The Internet is a club with a particularly challenging structure. Members are not equal, either in terms of taste or of endowment (Cornes & Sandler, 1996:351). They are likely to use the club's resources in very different ways (Cornes & Sandler, 1996:355).

In this setting, heavy users get more value for money. They pay the same price as light users, but they are responsible for more Internet traffic. Is this a normative problem? Would more specific property rights be desirable as a remedy? The answer obviously depends on the norm. One may criticise the result from a distributional perspective. But is it also inefficient? Are people deterred from buying Internet access? Research on the proper definition of cross-subsidies has demonstrated that the answer is not straightforward (Faulhaber, 1975). Light users might need heavy users to get the Internet they want. This may be for qualitative reasons. Heavy users might not only be heavy downloaders. They might be more likely than light users to upload material to the Net that light users desire to download. Heavy users are also more likely to push the further development of the Internet. In quantitative terms, it is only warranted to speak of a subsidy if the cost of serving heavy users is above the additional revenue they contribute. The underlying logic is one of cooperative game theory. There is a subsidy only if a coalition of light users would be better off by separating itself from the all-encompassing Internet. Conversely, prices are subsidy free if the resulting revenue vector lies in the core of the game (von Neumann & Morgenstern, 1944).

When introducing the concept of a club good, we specified consumption the following way: There is no technology for making additional use of the club's resources conditional upon additional contributions to the cost of their provision. This opens up the possibility that the club's resources will be overused. The risk of crowding is indeed characteristic for club goods. Accepting new members has a positive crowding cost. If the club management maximises profit, it will extend membership only if the crowding cost is outweighed by revenues from the additional access fees (Cornes & Sandler, 1996:348). On the Internet, crowding is anonymous, meaning that other users do not care who crowds the Net. They are only interested in the quality of service (cf. Scotchmer, 1987).

On this basis, we can be more specific with respect to the situation light users expect if they join a club that treats all users equally. In technical parlance, the Internet is a "best efforts network". There is no guaranteed quality of service. Providers only promise to make all resources available to users with whom they have contracts. If too much activity coincides at one point in time, qual-

ity deteriorates. Downloads take more time. Some data packages never arrive. Connections break down. Voice-over IP is particularly sensitive to this, since communication partners want to interact simultaneously. If missing data packages arrive even seconds later, they are useless.

On the Internet, crowding can take two different forms. In the first case, overall traffic increases. Most of the time more resources are needed for this. This form of crowding occurs whenever a new type of data-intense activity is shifted to the Internet. Voice-over IP is precisely one such development, as is file sharing in peer-to-peer networks. For this type of crowding, the argument developed thus far applies. If they do not discriminate among the types of users, Internet access providers must find the right mix between access prices and investment in the enlargement of the Internet (which could also take the form of payments to independent providers of the backbone).

In theory, the opportunity structure changes if one adds the second type of crowding. In this situation, club members are not permanently in conflict with each other. In ordinary periods, the club's resources suffice to serve everybody's needs. However, demand is not stable over time. There are peak periods when resources are insufficient to meet the total demand. In principle, this peak-load problem is characteristic for all communications networks. In anticipation, in off-peak periods, communications networks are heavily redundant. However, the very fact that communication over the Internet is split up into tiny data packages makes the Internet much less sensitive to peak-load problems than ordinary communications networks. There are three reasons for this. Data packages can take many ways. Consequently, if the most direct line is busy, there are multiple bypasses. Moreover, all types of communication use the same network. As a consequence, traffic of different types may be averaged out. Finally, the worldwide character of the Internet provides room for some averaging across time zones.

However, although it is attenuated, the peak-load problem is still present. In principle, it could lead to an additional incentive problem. It is individually rational to appropriate as much of the resource, as early as possible. In peak periods, this would give the club good the additional character of a common pool resource (cf. Hartwick & Olewiler, 1998). However, packet switching elegantly solves this problem. It makes no sense to start communication sometime before the expected peak period. This does not allow network capacity to be reserved for oneself. Once the peak is reached, this connection is as shaky as connections that started later. Club members thus lack a technology for appropriating resources in peak periods. Another way of making the point is this. Since Internet service providers only promise best efforts, they have established what in the energy industry is called an interruptible contract. By way of such contracts with (mainly commercial) customers, energy companies substantially reduce the peak load, and thereby the overall cost of the grid and production facilities (Gedra & Varaiya, 1993).

The fact that voice-over IP providers guarantee only best efforts even helps mitigate the shifting peak problem. In switched telephony, providers traditionally tried to combat peak loads by charging higher prices in time slots with particularly high demand. This induced many to shift communication to directly after the high-cost period. On a best efforts network, the difference between high and low performance is endogenous. It results from demand, not from any imposed

borderlines. Every user independently makes a trade off between the preferred time for communication and the probability of cumbersome traffic.

c) Bringing More Specific Property Rights Back In

In switched telephony, both property rights are side-effects of technology. Telecommunications companies do not face an extra exclusion cost. If telephony moves to the Internet, neither property right is automatic. However, this is not to say that it is technically impossible to bring them back in. The already mentioned software by Narus is able to block all voice-over IP, or only some of it, like the services of Skype. To that end it relies on stateful packet inspection. That technology makes it possible in principle to block individual instances of communication. Moreover, governments insist on tools for wiretapping. Technically, this is feasible only if individual data packages are assembled before the ultimate user receives them. Providers could exploit this technology to charge users for individual instances of communication.

If telecommunications companies implement any of these technologies, this is how they set up new property rights. It is not unusual for new property rights to emerge when a resource becomes more valuable. For instance, American law developed property rights for wild game only after furs had become expensive (Demsetz, 1979). This is efficient if the overall transaction cost of establishing and administering the property right is smaller than the benefit from exclusion. Demand for the ultimate consumption good must be sufficient to cover not only the production cost, but also the exclusion cost.

In institutional practice, property rights are often defined by the legal order. But this is not the only possibility. Take the owner of a shopping mall. She may offer parking space for free to attract customers. But she may also rely on her title to the land to charge a parking fee. By doing so, she establishes a private property right. Likewise, telecommunications companies may rely on their freedom of contract. They may make access to their network conditional upon the acceptance of the technology they use for setting up additional property rights in communications. If they do, however, they should be prepared for political resistance. The Internet community is likely to perceive these interventions as attempts to privatise the Internet. This would run counter to the fundamental egalitarian convictions on which the Internet is based (David, 2001; Engel, 2005). Internet activists might also be afraid that the end-to-end principle (Saltzer, Reed, & Clark, 1984) will be put at risk. It would be hard to prevent those users who currently generate the highest revenues from having an impact on the basic structure of the Net. If so, it would no longer be possible for everybody to communicate with everybody else in whichever way they see fit. If the political movement for "network neutrality" wins the day, this political resistance might even translate into regulatory oversight over the establishment of additional property rights.[8]

8 For background see http://www.timwu.org/network_neutrality.html ; http://www.ftc.gov/speeches/majoras/060821pffaspenfinal.pdf (at 13-21).

An alternative strategy for establishing finer grained property rights is both cheaper and less politically salient. Telecommunications companies can rely on their property right in access to discriminate among different classes of users (Cornes & Sandler, 1996:347). That way, they can set up a quasi-market for the club good (Cornes & Sandler, 1996:378 f.). They still face a transaction cost. Yet it is not for exclusion, but for discrimination. One way of discriminating is very cheap and therefore widely used. Telecommunications companies charge a higher access price for larger bandwidth. This is still a fairly imperfect property right. It only establishes an upper limit per unit of time. In practice, tariffs usually only have a few steps. For instance, many providers charge households a disproportionately high price for very large bandwidth in order to deter users from participating in peer-to-peer networks.

Property rights could become more specific and meter actual use (cf. Helsley & Strange, 1991). Or higher prices could be set for peak periods (cf. Crew, Fernando, & Kleindorfer, 1995). A number of economists have suggested this for quite some time (MacKie-Mason & Varian, 1995; Odlyzko, 1998; Thomas, Teneketzis, & MacKie-Mason, 2002).

At first blush, each of these additional property rights appears doomed to failure for the very reason that they are private; for there is lively competition on the market for Internet access. Each of these property rights targets customers who impose a disproportionate burden on the network, or who desire network services more than the average user. The additional property rights are meant to extract a higher price from such customers. Why should they accept this as long as competing telecommunications companies do not discriminate? For an extended transition period, uniform and discriminate prices might indeed coexist. Ultimately, however, this situation is not sustainable. Heavy users would all go to access providers with weak property rights. In order to cover the higher cost, these providers would have to charge all their customers higher prices. Light users would no longer find these tariffs attractive, and they would move to providers with more specific property rights. Eventually, customers would self-select.

While exclusion therefore is technically and economically possible, it is unlikely to ever be anywhere close to perfect. Providers can set up technical barriers. But there will always be some users who are inventive enough to bypass the barriers. File sharing in peer-to-peer networks illustrates that such bypassing can be economically significant. The example also demonstrates that the problem of circumvention is not confined to privately enforced property rights; for the music industry has convinced the legislators of many countries to make copyright violations a criminal offence. Nonetheless peer-to-peer networks are thriving. If telecommunications providers engage in the implementation of more fine grained private property rights, one should therefore expect something like a technological arms race.

3. The Lost Property Right in the Customer Relationship

Little trade is on the spot. Normally, suppliers treat their customers well, hoping that they will come back next time. There are many techniques for endowing customer relationships with even greater stability. A classic example are rebates. The rebate is lost if the customer switches to a different provider (Greenlee & Reitman, 2005). The rebate may be interpreted as a tool for establishing a property right in the customer relationship.

For a technical reason, in classic switched telephony, providers had a fairly strong property right in the customer relationship. This was due to the already mentioned fact that these networks need numbers to establish connections. These numbers follow the logic of the network. If the caller punches in ++49, the local switch routes this call to Germany. Similar codes tell long-distance from local calls, and so forth. In order to guarantee the smooth functioning of the entire telephone network, there is a numbering plan provided by the International Telecommunications Union, i.e. by a governmental international organisation (more from Hwang & Mueller, 2003:5). National regulatory bodies give out blocks of numbers listed in this plan to telephone network providers. Originally, if a customer wanted to change the telephone network, she also had to change her telephone number. She thus had to tell everybody that the old number no longer worked. Admittedly, this property right has been weakened in recent years. However, in order to more clearly highlight the implications of the technical shift for competition, these alterations are assumed away for the moment. They will be taken up at the end of this section.

If voice communication shifts to the public Internet, the technical reason for tying customers to their providers vanishes. Ordinary IP addresses suffice. For mnemotechnical reasons they may be translated into domain names or indeed into numbers that look like traditional telephone numbers.[9] But there is no technical reason to make the use of such numbers conditional upon the agreement of the provider. As is standard with domain names, it would be natural to allocate the property right in these addressees to users.

The parallel to the e-mail address is telling. The cost of informing everybody about a new e-mail account is not much smaller than that of informing them about a new telephone number. But there is no technical or economic reason why I should hold an e-mail account given out by my telecommunications company, or by my Internet service provider. There are many independent providers of e-mail accounts. Those who want to be fully autonomous can even register a domain and be their own provider of the e-mail address.

The shift of voice communication to the Internet would have two effects on competition. First, a property right in the customer relationship leads to a situation of monopolistic competition (Chamberlin, 1933). While there is some competitive pressure, customers are unlikely to switch to another provider. The new offer must be attractive enough to outweigh the switching cost. Admittedly, this is not the whole story. Systems competition for new customers has beneficial

9 http://www.ietf.org/rfc/rfc3261.txt?number=3261, point 8.1.1.3, see also point 19.1.6.; further see http://www.ietf.org/rfc/rfc2806.txt?number=2806.

side-effects for those who are unlikely to switch (Beggs & Klemperer, 1992). But competitive pressure still is reduced.

The second effect is illustrated by the current situation in mobile telephony in most countries. While the US and a few more countries adhere to the receiver-pays principle, most countries have adopted the competing caller-pays principle. Under the latter principle, the caller pays for the entire call; the receiver pays nothing. Since there is effort in the receiver's network, the caller's provider has to pay a termination charge. Termination charges are a constant concern for competition policy. Under the receiver-pays principle, each provider necessarily holds a monopoly on terminating calls to her customers.[10] As one should expect, this monopoly power is used. Moreover, many mobile phone companies add mark ups to the termination charges they have to pay. This is hard for customers to resist if they want to be connected outside their own network. The monopoly power of the network of destination then translates to the network of origin. Under the receiver-pays principle, none of these problems exists (Crandall & Sidak, 2004; Doyle & Smith, 1998; Hermalin & Katz, 2004; Littlechild, 2004).

On the Internet, the receiver-pays principle is standard. Nobody complains that she has to pay for Internet access and Internet service provision if she wants to go to a website, or to use instant messaging. Of course, as the US example demonstrates, the receiver-pays principle can be combined with traditional telephone numbers. However if providers have a property right in telephone numbers, in principle they can use this property right to insist on termination charges. It is only through large-scale regulatory intervention that the competing principle may be established. However, if the property right belongs to the customer in the first place, it is no longer possible to impose the caller-pays principle.

In reality, the picture is more nuanced. In switched telephony, there have always been sub-networks with a number space beyond the control of the telecommunications company. Traditionally these networks have mainly been used for intra-firm or intra-organisation communication. Such organisations provide their employees with extension numbers. Recently, however, sub-networks have also been used by resellers. That has allowed them to give out telephone numbers to their customers without authorisation from the regulatory authority.[11] However, unless forced by the regulator, a telecommunications company need not agree to this.

The right of customers to port telephone numbers from one provider to its competitor is now standard all over the world. This reduces switching costs to the much smaller effort entailed in porting.

Conversely, there are two business models for voice-over IP. The one implemented by companies like Vonage more or less aligns with what has been sketched out above. By contrast, services like Skype restrict free calls to communication with those who are also customers of the

10 EC Commission May 17, 2005, http://europa.eu.int/rapid/pressReleasesAction.do?reference=MEMO/05/162&format=HTML&aged=1&language=EN&guiLanguage=en.

11 Remarkably, providers of voice-over IP have been keen to use this bypass.

company. This gives them even more control over their customer base than providers of switched telephony ever had. If a customer switches to another provider of voice-over IP, she loses (gratuitous) access to all the customers of her previous provider.

4. Lessons for the Systems Competition Between Switched and Internet Telephony

While voice-over IP is growing rapidly, in absolute terms it still is a fringe phenomenon. Although many observers believe it to be the technology of the future, it still has a long way to go before it alone is the predominant technology. Even in the long run, switched telephony might remain. So far, for local calls the production cost of IP traffic is higher than for switched traffic (Davies et al., 2004:397; Mertens, 2000:80). Speech quality is acceptable only above 300 kBit/sec. If one wants to simultaneously use a second line, be it for voice or other purposes, this only works with broadband access. In practical terms, at present this typically either means cable or DSL. The fixed cost is thus rather high. Persons with only a few calls a month might never find this sufficiently attractive. If this describes user preferences correctly, there would be systems competition between switched and packet switched voice communication. At any rate, this systems competition will be present for years to come.

Since they are so small, voice-over IP providers tend to present this competition of systems as a battle between David and Goliath. There is indeed no reason to believe that the providers of fixed and mobile switched telephony are sanguine about the new competitive pressure. It will at least cut into their profits from long-distance and international calls. High charges for roaming might come under pressure. If the transition is fast, previous investment into switches might become sunk (on sunk costs, see Williamson, 1985:chapter 2). This might lead to a situation of ruinous competition (Breyer, 1982). In the interest of attracting as much of the remaining switched traffic as possible, individual providers might be tempted to offer prices below long-run average cost. Anticipating this eventuality, the providers of switched telephony might feel the urge to slow down the transition.

This creates a profound dilemma for competition policy. Despite all interventions, in most countries the market power of previous telecommunications monopolists is still significant. At least up till now, most of them are not very active in the voice-over IP market. Systems competition between switched and packet switched telephony is therefore welcome news. Regulators might see themselves as natural allies of the new technology. If the regulatory framework makes voice-over IP a profitable business, this would attract new market entry. Competitive pressure on the former telecommunications monopolists would mount.

In practical terms, voice-over IP providers will rely on this line of argument when they call for two rights: the right to give out classic telephone numbers to their customers; and the right to make money from charging termination rates and from adding markups to the termination charges they themselves have to pay. The second is attractive for all types of voice-over IP. The

first is of interest for services like Vonage. If they are allowed to use classic telephone numbers, this makes the switch to Internet telephony smoother for customers. However, if the shift occurs in this way, then voice-over IP inherits the tool for establishing a property right in the customer relationship from switched telephony. Regulators thus face a hard choice. If they do what is good for systems competition now, they risk petrifying an anti-competitive opportunity structure that made best sense in switched networks. This paper is not able to offer an easy solution to the dilemma. All it can do is draw regulators' attention to the detrimental long-term effects of apparently innocuous moves today. Or to put this in terms of the metaphor, to show that by treating voice-over IP providers as Davids today, regulators might rear the Goliaths of tomorrow.

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